Characteristics of Cold Air Outbreaks in the Great Plains and Their Subseasonal Predictability Potential

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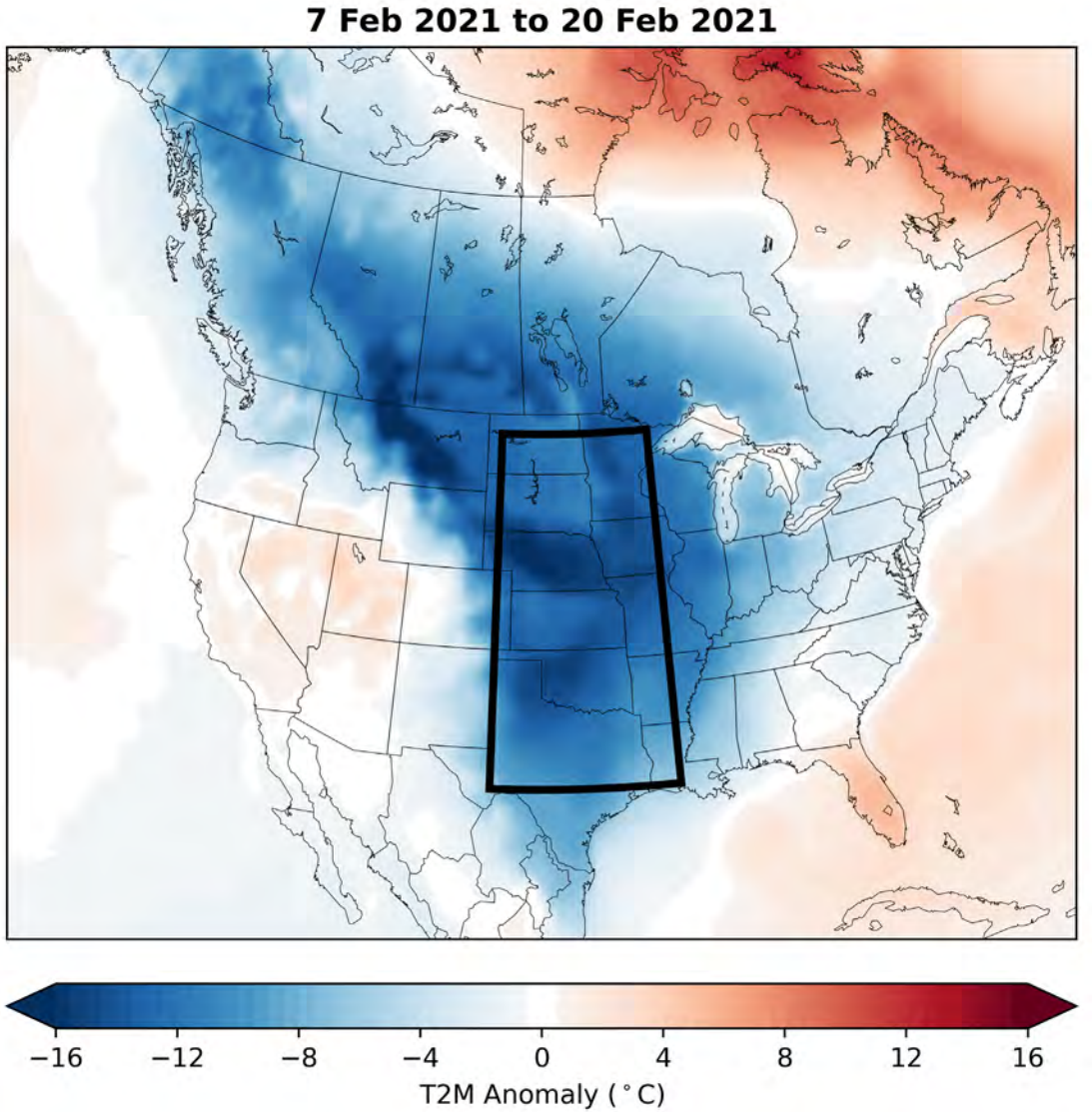
Motivation

- Wintertime cold air outbreaks (CAOs) are **high-impact** extreme events.
- The **February 2021 CAO** in the Great Plains featured **very cold temperatures.**
- **Widespread power outages** occurred in Oklahoma and Texas due to surging heating demand.

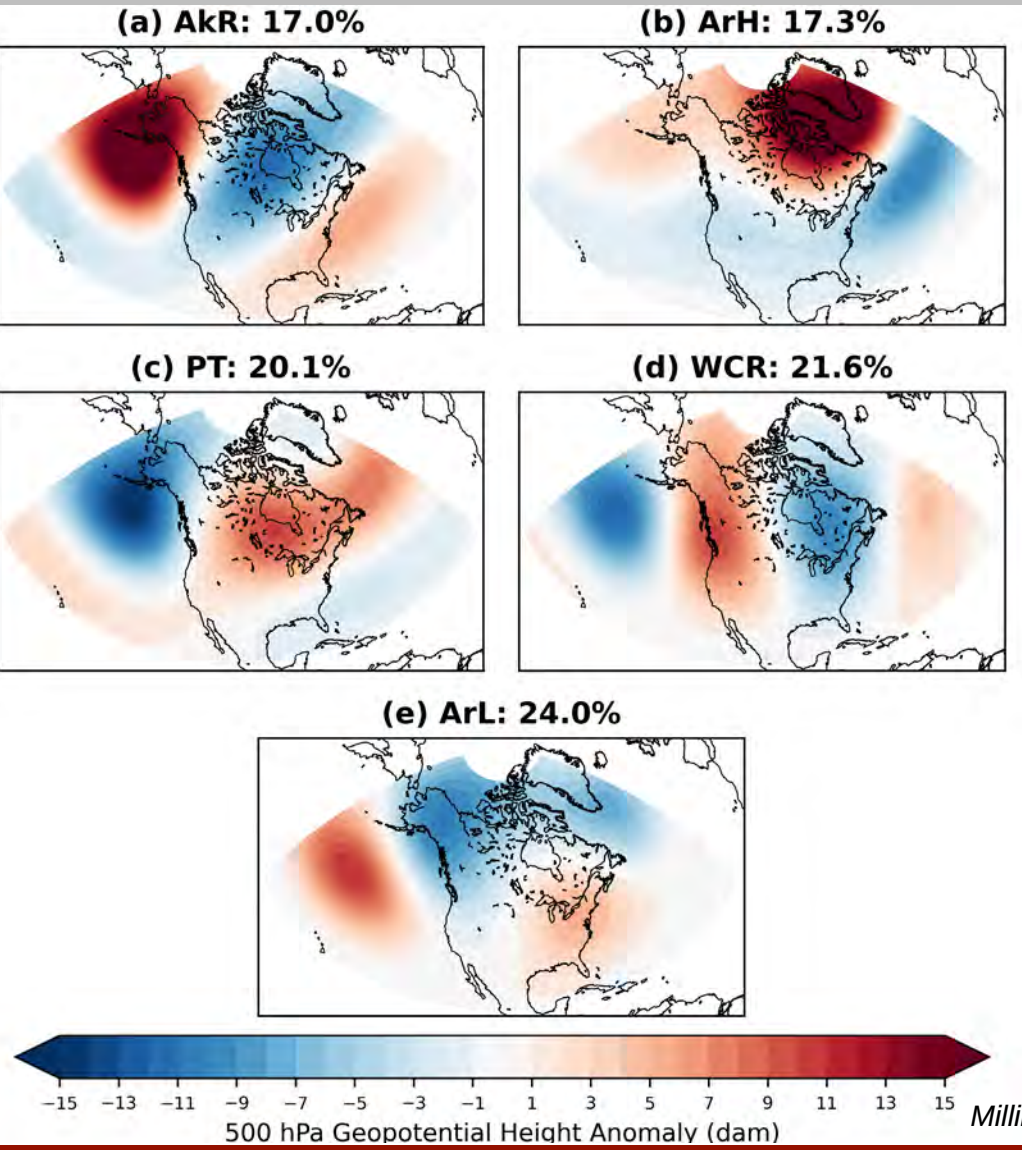
- **<u>What are the dynamics/characteristics of these events, and could this lead to predictability potential on the subseasonal to seasonal (S2S) timescale of two weeks to two months?</u>**



Defining Great Plains CAOs

- **<u>37 Great Plains CAOs defined (1950-2021):</u>**
- 5+ consecutive days below 10th percentile of DJF Great Plains T2M anomaly.
- 4+ days separation.

- Each CAO is categorized by its weather regime on onset day; **18 ArH-CAOs, 12 AkR-CAOs, and 7 WCR-CAOs.**



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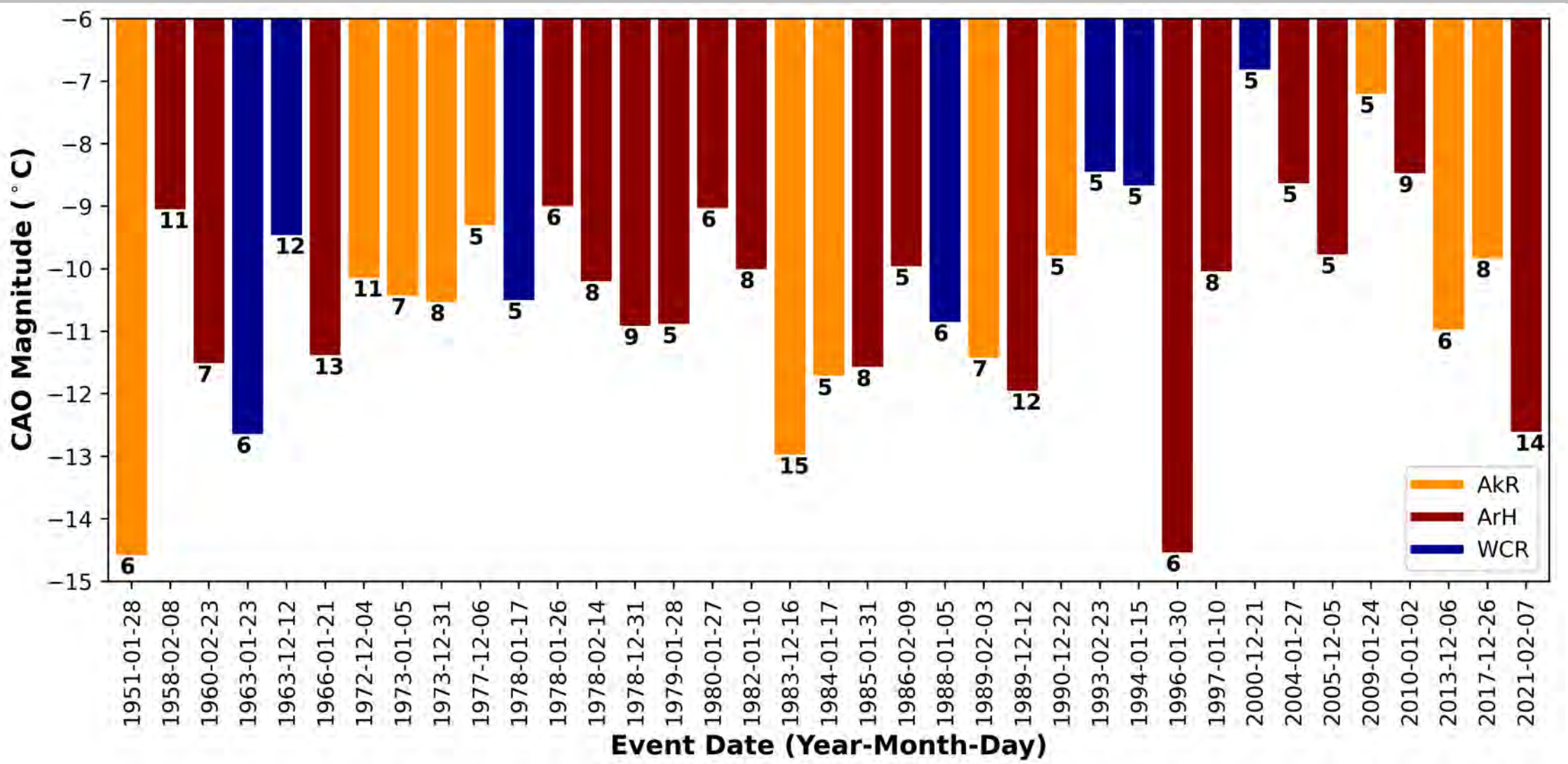
The Great Plains CAOs



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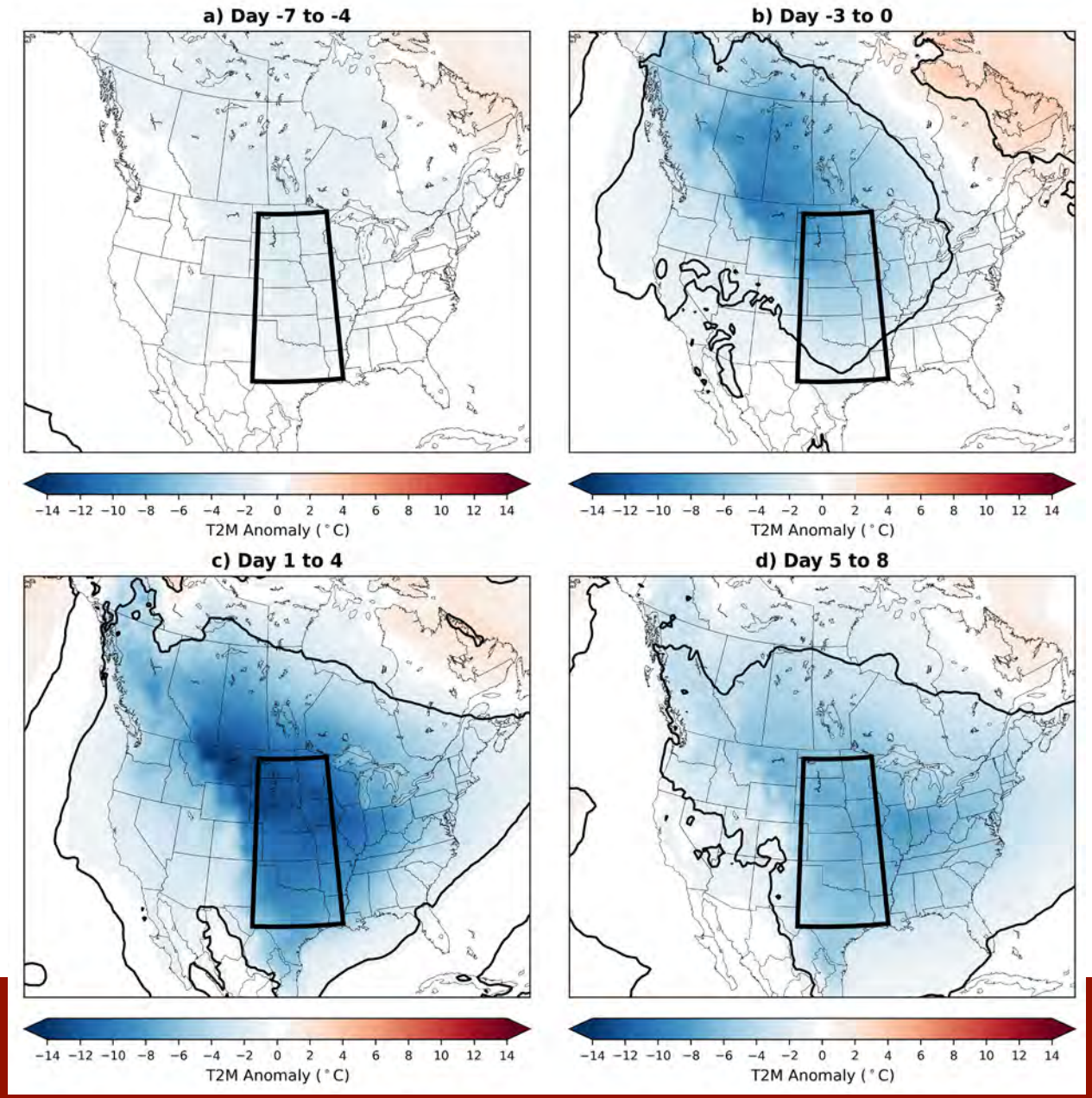
2m Temperature Anomaly Composites



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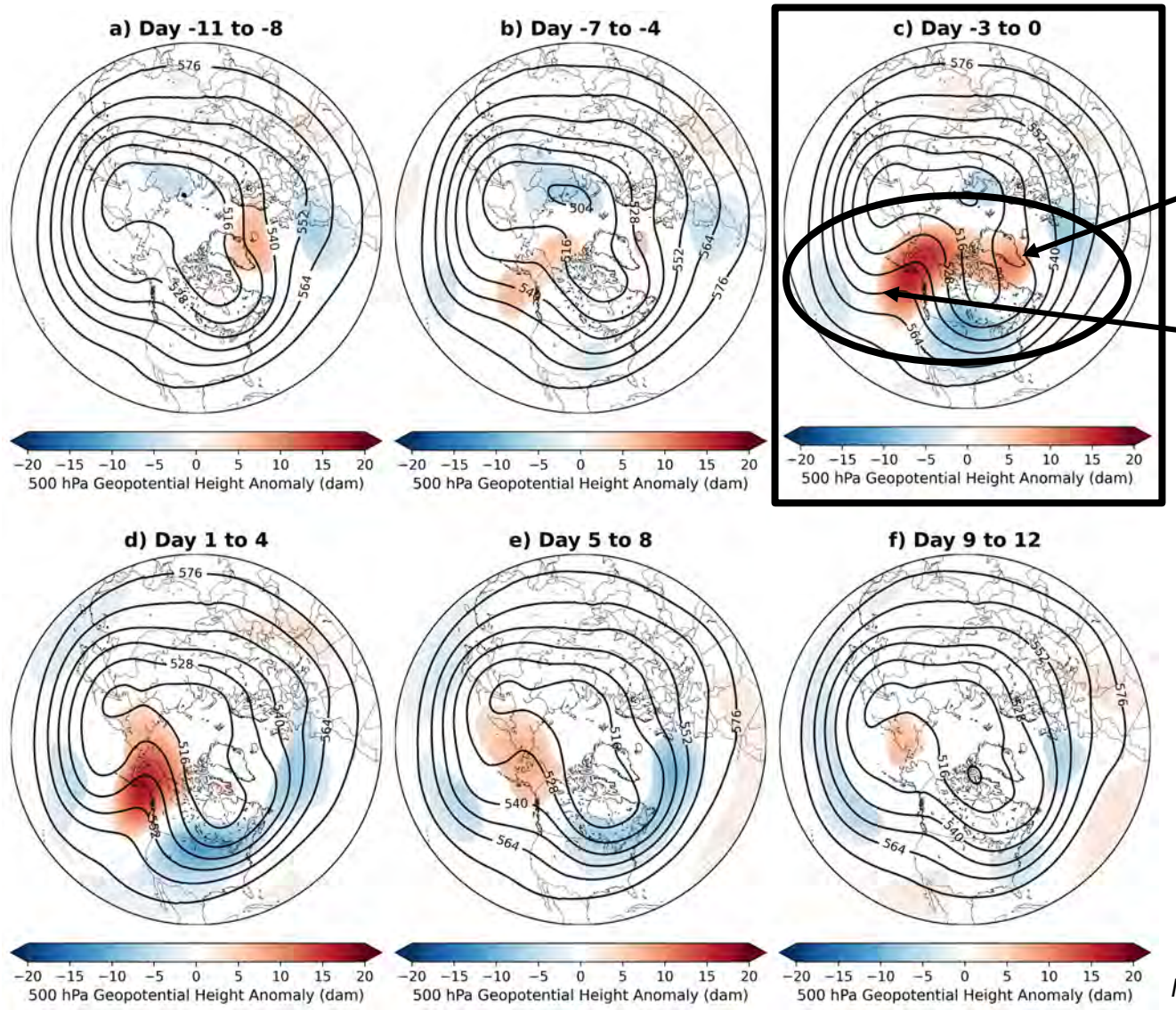
Circulation Anomaly Composites



Arctic High (ArH)

Alaskan Ridge (AkR)

The ArH and AkR have previously been associated with CAOs and stratosphere polar vortex (SPV) variability.

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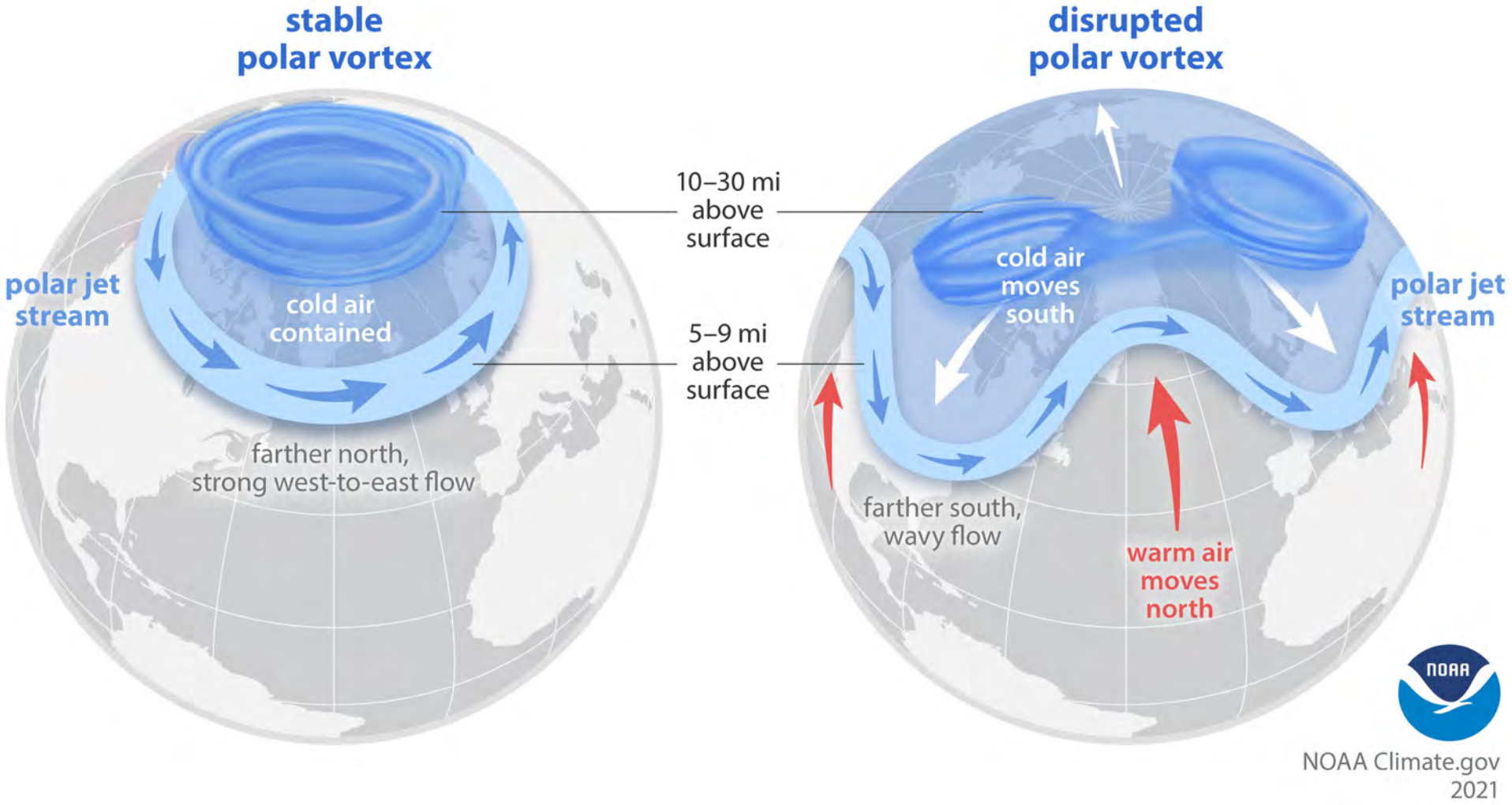
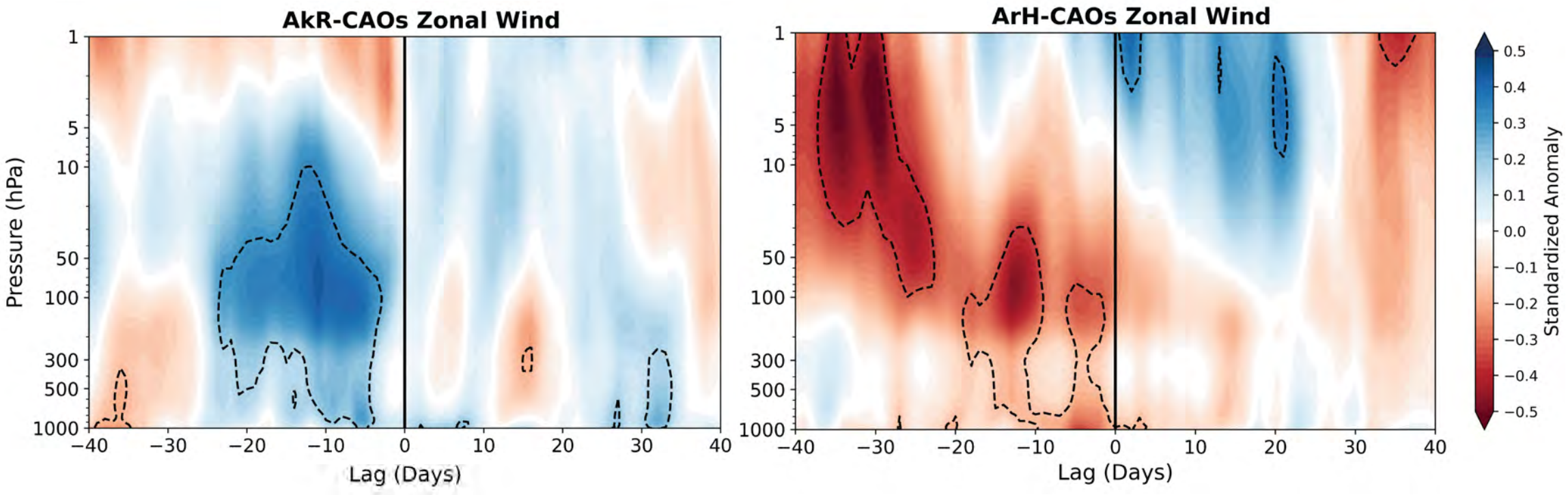
The Stratospheric Polar Vortex



NOAA (2021).

SPV Variability



Strong Vortex

Weak Vortex

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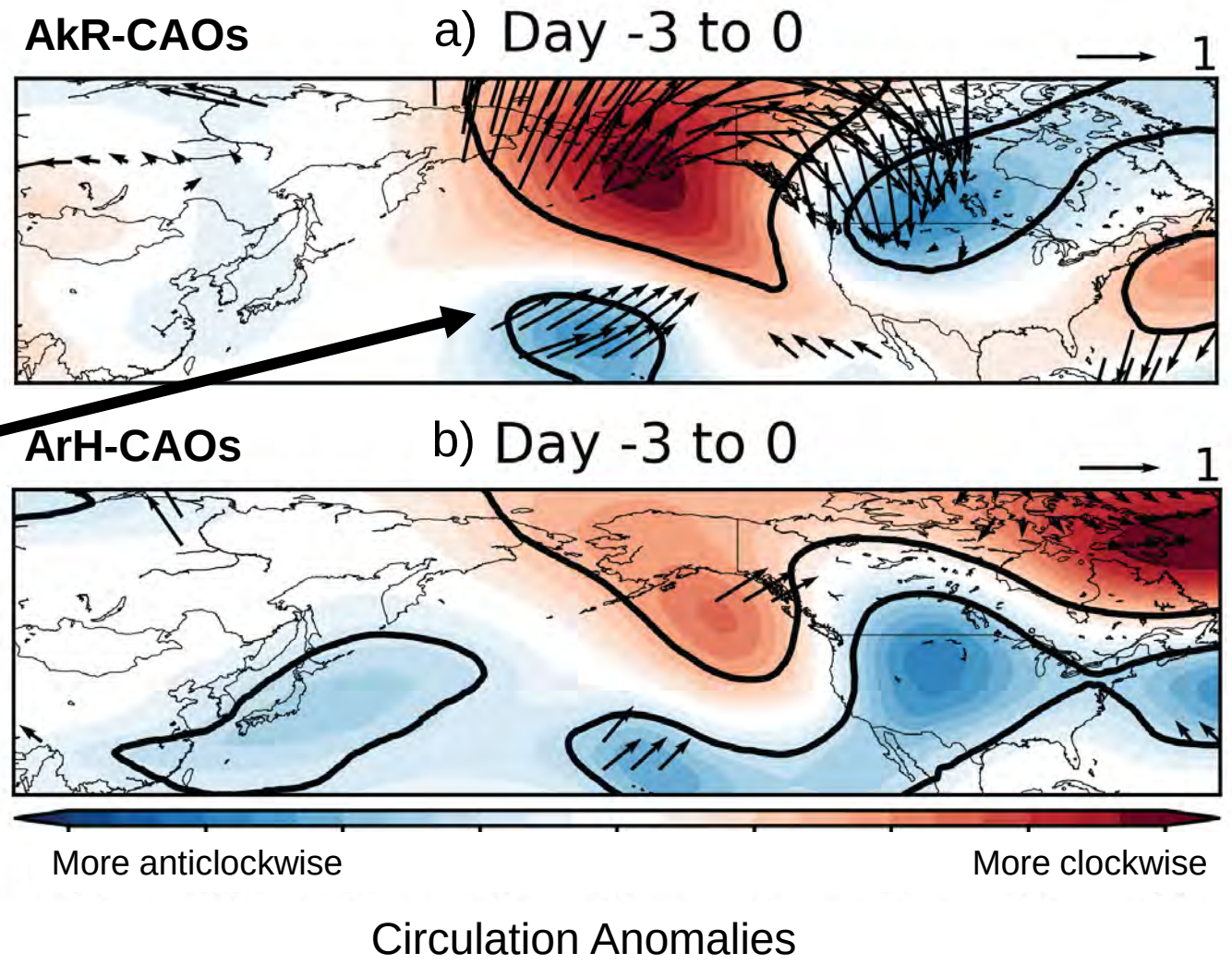
Two opposing signals suggest that **different forcing dynamics** may be occurring, with different S2S predictability potential.

North Pacific Energy Propagation

- **Rapid development of Pacific wave pattern for AkR-CAOs.**
- No significant wave pattern in the Pacific for ArH-CAOs.
- These results suggest that the development of AkR-CAOs could be related to **remote forcing from the tropics**, i.e., tropical thunderstorm patterns and El Niño.



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Summary and Future Work

1. The dominant onset day regimes for Great Plains CAOs were the Alaskan Ridge and the Arctic High.
2. AkR-CAOs involve a strong SPV and wave energy propagation, whereas ArH-CAOs feature a longer timescale downward propagation of weak SPV conditions.
3. Both types of Great Plains CAO have potential for S2S predictability through stratospheric and/or tropical connections.

Future Work

- Investigate the predictability of the February 2021 CAO in S2S models (in prep).
- Extend the S2S model analysis to predictability of AkR- vs ArH-CAOs.
- Further model/nudging experiments.

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